Wheat (*Triticum aestivum* L.) is the most important crop in the world. European Union (EU) is the largest wheat producer country. China is the leading wheat producer followed by India and Russia. India’s share in global wheat production is 13.1 percent in the year 2013-14. This crop provides 20% of the energy in human food. So to show the importance of wheat crop, it is essential to protect it from fungi that attack seedling growth resulting production of wheat was ultimately reduced every year.

Treatment of seeds with systemic fungicide is a conventional method used for the control of seed borne infection in intensive wheat production. Seed treatment with a proper formulation affects the initial development of plants which, in turn, will influence later stages of growth and development and finally yield levels. Seed treatment is a biological, chemical, mechanical or physical process designated to mitigate externally or internally seed or soil borne microorganisms, resulting in the emergence of a healthy seedling and subsequently a healthy plant. Seed treatment promote seedling establishment that enhance yield, improve quality and to avoid further spread of pathogens. Fungicide carbendazim is an active metabolite of benomyl and have properties similar to benomyl. This fungicide binds on β-tubulin in microtubules inhibiting their proliferation and suppressing their dynamic instability. Trade name of carbendazim is bavistin. It is broad spectrum fungicide therefore is applied to control wide range of fungal diseases. Germination of seed and early seedling growth are considered the most critical phases for establishment of any species of plant. Germination test determine the planting value of seed. Seed yield of any crop can be improved by treating the seed with fungicide before sowing.

The objective of this study was to evaluate the effect of different concentration commonly used Carbendazim on first count of germination, percent germination, root length, shoot length, fresh weight, seedling dry weight and vigour index-I on wheat cultivar-365.

**MATERIAL AND METHODS**

Wheat cultivar and fungicide were taken from Department of Genetic and Plant Breeding and Pathology, College of Forestry, Ranichauri. In present study, six different concentrations of carbendazim fungicide 500, 1000, 1500, 2000 and 2500 and 3000 mg/l were used for the treatment of wheat cultivar. Before treatment, wheat seeds were surface sterilized with 0.1% HgCl$_2$ for 5 min to remove dust that adhered on surface, then these seeds were washed thoroughly with distill water. After that 50 seed in four replication were planted in
petriplates. At the start of the experiment 4 ml of respective concentration was added to moisten filter paper in each petri plates and then every day 5 ml of respective concentration was added for consecutive 6 days. Three sets in each concentration were maintained along with the control for comparison. On 4th day of germination first count was taken to determine the speed of germination.

Germination percentage was estimated by using given formula. Seedling fresh and dry weight, 10 randomly selected seedling were weighed with the help of electronic balance, then these seeds were kept in an oven at 100 °C for 24 hour for estimation of seedling dry weight. Vigour index was calculated using the prescribed formula.

RESULTS AND DISCUSSION

Analysis of variance showed significant differences for seed quality parameters viz first count, standard germination, seedling length, seedling dry weight and seed vigour index-I of wheat cultivar VL-365 for different concentration of carbendazim fungicide (Table-2). First count germination percentage in control was 64% and at 500, 1000, 1500, 2000, 2500, 3000 mg/l concentration of fungicide were 65.50, 71.75, 82.00, 84.00, 76.50 and 72.50%, respectively. Highest increase in germination percentage (20.0%) was observed at 2000 mg/l concentration of fungicide.

Germination percentage in control was 64% and at 500, 1000, 1500, 2000, 2500, 3000 mg/l concentration of fungicide were 71.75, 82.00, 86.00, 84.00, 76.50 and 72.50%, respectively. Highest increase in germination percentage was observed at 1500 mg/l (22.0%) concentration of fungicide. Fungicide carbendazim highly influenced all the studied growth parameters of wheat variety. Germination percentage of fungicide treated seed gets increased with increase in concentration of fungicide germination was stimulated by thiamethoxam in soybean, pea and corn.

Root length of untreated wheat cultivar was 12.26 cm, whereas, at 500, 1000, 1500, 2000, 2500, 3000 mg/l were 12.28, 12.41, 13.22, 14.18, 16.02 and 13.75 cm respectively. Maximum percent increase root length (30.67%) was observed at 2500 mg/l concentration of fungicide over the control. Results were in agreement with the work done by earlier workers.

Table-1. Analysis of variance of different seed quality parameters of wheat cultivar VL-365.

<table>
<thead>
<tr>
<th>Source of variation</th>
<th>First count</th>
<th>Germination %</th>
<th>Root length (cm)</th>
<th>Shoot length (cm)</th>
<th>Fresh weight (mg)</th>
<th>Dry weight (mg)</th>
<th>Seed vigour index-I</th>
</tr>
</thead>
<tbody>
<tr>
<td>Treatment</td>
<td>6</td>
<td>232.917**</td>
<td>253.81**</td>
<td>7.446**</td>
<td>9.277**</td>
<td>0.235**</td>
<td>0.002**</td>
</tr>
<tr>
<td>Error</td>
<td>21</td>
<td>3.130</td>
<td>2.24</td>
<td>0.099</td>
<td>0.063</td>
<td>0.002</td>
<td>0.0002</td>
</tr>
</tbody>
</table>

Table-2. Mean value of first count, germination percentage, root length, shoot length, fresh weight, dry weight and seed vigour index-I of wheat cultivar VL-365 at different concentration of carbendazim.

<table>
<thead>
<tr>
<th>Treatment (mg/l)</th>
<th>First count</th>
<th>Germination %</th>
<th>Root length (cm)</th>
<th>Shoot length (cm)</th>
<th>Fresh weight (mg)</th>
<th>Dry weight (mg)</th>
<th>Seed vigour index-I</th>
</tr>
</thead>
<tbody>
<tr>
<td>400</td>
<td>65.50</td>
<td>71.50</td>
<td>12.28</td>
<td>10.21</td>
<td>0.95</td>
<td>0.12</td>
<td>1807.72</td>
</tr>
<tr>
<td>1000</td>
<td>71.75</td>
<td>82.00</td>
<td>12.41</td>
<td>10.34</td>
<td>0.98</td>
<td>0.12</td>
<td>1805.27</td>
</tr>
<tr>
<td>1500</td>
<td>82.00</td>
<td>86.00</td>
<td>13.22</td>
<td>13.41</td>
<td>1.18</td>
<td>0.11</td>
<td>2290.82</td>
</tr>
<tr>
<td>2000</td>
<td>84.00</td>
<td>84.00</td>
<td>14.18</td>
<td>12.58</td>
<td>1.23</td>
<td>0.08</td>
<td>2248.22</td>
</tr>
<tr>
<td>2500</td>
<td>76.50</td>
<td>79.50</td>
<td>16.02</td>
<td>11.21</td>
<td>1.58</td>
<td>0.06</td>
<td>2183.85</td>
</tr>
<tr>
<td>3000</td>
<td>72.50</td>
<td>72.50</td>
<td>13.75</td>
<td>10.24</td>
<td>0.94</td>
<td>0.12</td>
<td>1853.23</td>
</tr>
<tr>
<td>Control</td>
<td>64.00</td>
<td>64.00</td>
<td>12.26</td>
<td>9.02</td>
<td>0.91</td>
<td>0.13</td>
<td>1446.54</td>
</tr>
<tr>
<td>SCh</td>
<td>0.89</td>
<td>0.89</td>
<td>0.16</td>
<td>0.12</td>
<td>0.019</td>
<td>0.007</td>
<td>22.07</td>
</tr>
<tr>
<td>CD (5%)</td>
<td>2.50</td>
<td>2.02</td>
<td>0.46</td>
<td>0.36</td>
<td>0.537</td>
<td>0.019</td>
<td>64.91</td>
</tr>
</tbody>
</table>
Shoot length of untreated wheat cultivar was observed 9.02 cm and range of shoot length at 500, 1000, 1500, 2000 and 2500, 3000mg/l concentrations of fungicide was 10.21 to 13.41cm. The highest increase of shoot length was 48.68% at 1500 mg/l concentration of fungicide.

Vigour index of untreated wheat cultivar was 1446.54. Vigour index at 500, 1000, 1500, 2000 and 2500 mg/l concentrations were 1607.72, 1865.27, 1865.27, 2290.82, 2248.22, 2163.83 and 1853.25 respectively. Thus, among the entire studied concentration, highest % increase in vigour index i.e. 58.36% was observed at 2000 mg/l concentration of fungicide. Seedlings treated with thiamethoxam had a particular advantage of improved seedling vigour.

Due to presence of fungicide water retention capacity of seedlings was enhanced that would favour growth of seedling which increases seed yield.

Fresh weight of untreated wheat cultivar was 0.91gm. Fresh weight at 500, 1000, 1500, 2000 2500 and 3000 mg/l were 0.98, 1.18, 1.23, 1.58, and 0.94gms, respectively. The highest % increase in fresh weight was 73.62%, followed by 2500 mg/l of fungicide over the control. These results were in parallel with the findings of some earlier workers.

In control, dry weight was observed 0.13gms. Dry weight at 500, 1000, 1500, 2000 and 2500 mg/l concentration of fungicide were 0.12, 0.12, 0.11, 0.08, 0.08, and 0.12gms, respectively. The highest percent decrease of dry weight (~38.57%) at 2000 and 2500 mg/l concentration of fungicide over the control.

CONCLUSION

The main aim of the present study was to determine best concentration of carbenzimid fungicide that enhanced the seedling growth of wheat. Appropriate concentration of fungicide that enhance germination and seedling growth of wheat were 1500, 2000 and 2500 mg/l. So from this study it can be suggested to farmers that before seed sowing, seeds of wheat should be treated with 1500, 2000, and 2500mg/l concentration of carbenzimid which will prevent the attack of fungi responsible for the damage of crop growth and ultimately reduces the seed yield.

REFERENCES